PRESSURIZER FOR A ROCKET ENGINE

BACKGROUND

[0001] Rocket engines require propellants to be fed to them at very high pressures. This has historically been accomplished in two general ways: first, with the use of a pressurized fluid, such as high pressure helium; and second, with the use of a pump. In the first way, a pressurized fluid is added directly to the propellant tank and exerts a force on the propellant. Nitrogen and helium, both inert gases, pressurized to a pressure as high as 50,000 PSI, have been used successfully in the past. As they are inert, there need be no barrier (e.g. membrane or piston) placed between these pressurized fluids and the propellant. The problem with this method, however, is that the pressurized fluid also exerts a force on the propellant tank. Because of the extremely high pressures required of the pressurized fluid, the walls of the propellant tank must be thick enough to withstand the pressure. The propellant tank is therefore very heavy. Rockets employing the pressurized fluid must use a greater proportion of their thrust lifting this extra weight, and therefore they are not as efficient as rockets that do not require this added weight.

[0002] Historically, one way to solve the above weight problem is to employ the use of a pump. Pumps (e.g. reciprocating or centrifugal pumps) are generally very complex and require their own driving means, such as an engine. Further, the engine driving the pump burns a significant percentage of the total propellant. For small rocket engine systems, since a pump is too complicated and too heavy, pressurized fluids are generally used to pressurize the propellant. However, for large rocket engine systems, pumps have the advantage that the walls of the propellant tank need not be thick, since there is little or no pressure in the tank. Therefore, the propellant tank is much lighter, and the added weight of the pump is more than offset by the reduction in propellant tank weight.

[0003] U.S. Pat. No. 3,213,804 to Sobey discloses fluid pressure accumulators that are connected to sources of low and high pressure by means of butterfly valves. Essentially, the pressurized fluid exerts force on the propellant in small, designated containers. While the walls of these containers must be thick in order to withstand the high pressure of the pressurized fluid, the walls of the propellant tank need not be. Therefore, the total weight of the rocket engine system employing Sobey's invention may be less than that of the previously discussed rocket engine system because these containers (fluid pressure accumulators) are small in comparison to the propellant tank.

[0004] A problem with Sobey's invention, however, is its complicated use of valves. In order to reduce the weight of Sobey's invention further, the sizes of the fluid pressure accumulators must decrease (thus reducing their weight). However, as they decrease, the rotation speed and precision of the butterfly valves must increase in order to accommodate the same propellant flow rate to the rocket engine. This places great stresses on the valves, and eventually a point is reached at which the valves cannot reliably rotate fast enough to provide the required timing.

SUMMARY OF THE INVENTION

[0005] The present invention provides for a pressurizer for pressurizing a fluid, comprising a pressurant entrance for the introduction of a pressurant, a fluid entrance for the fluid, a fluid exit for the fluid, and a transfer chamber movable in a cycle with respect to the fluid exit, where for a portion of a cycle the pressurant exerts a force on the fluid inside the transfer chamber. In a preferred aspect of the present invention, the pressurizer further comprises a spindle housing more than one transfer chamber, rotatable about an axis between the fluid entrance and the fluid exit. In another preferred aspect, the transfer chamber comprises either a flexible membrane or a movable piston to separate the pressurant and the fluid. In another preferred aspect, the pressurizer further comprises a pressurant exit for a pressurant exhaust. In another preferred aspect, the pressurant exhaust is exhausted in a direction substantially opposite a direction of motion of the transfer chamber. In another preferred aspect, the pressurizer further comprises a motor to move said transfer chamber. In another preferred aspect, a cross section of the pressurant entrance is larger than a cross section of the fluid exit, and a cross section of the pressurant exit is larger than a cross section of the fluid entrance. In another preferred aspect, a cross section of the fluid entrance is greater than a cross section of the fluid exit.

[0006] The present invention also provides for a rocket engine system, comprising a pressurant, a pressurant container, a propellant, a propellant container, a rocket engine, and a transfer chamber movable in a cycle with respect to the rocket engine, where for a portion of a cycle the pressurant exerts a force on the propellant inside the transfer chamber. In a preferred aspect, for a portion of a cycle a bouyant force causes the propellant to flow into, and the pressurant to flow out of, the transfer chamber. In another preferred aspect, the rocket engine system further comprises a heating means for heating the pressurant, where the heating means comprises a heat conductor for conducting heat from the rocket engine to the pressurant. In another preferred aspect, a pressurant exhaust exerts a force on the propellant inside the propellant container. In another preferred aspect, the propellant comprises an oxidizer and a fuel. In another preferred aspect, the rocket engine system further comprises an engine conduit between the transfer chamber and the engine and a propellant conduit between the transfer chamber and the propellant container, where a cross section of the propellant conduit is greater than a cross section of the engine conduit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] **FIG. 1** shows a schematic view of a rocket engine system employing the pressurizer described herein.

[0008] **FIG. 2** shows a perspective view of a preferred embodiment of the pressurizer described herein.

[0009] **FIG. 3** shows a perspective view of the pressurizer in **FIG. 2** without the spindle.

[0010] **FIG. 4** shows a perspective view of the spindle.

[0011] **FIG. 5** shows a cut-away view of **FIG. 4**.

[0012] **FIG. 6*a*** shows a top view of the top chamber separator.

[0013] **FIG. 6*b*** shows a bottom view of the bottom chamber separator.

[0014] **FIG. 7** shows a perspective view of the pressurizer in **FIG. 2** with a motor.